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Society for the Encouragement of Arts, Manufactures, and Commerce,

JOHN-STREET, ADLPHI, LONDON, W.C.

EXAMINATION PAPERS

SET AT THE

FINAL EXAMINATIONS OF THE SOCIETY OF ARTS,

HELD IN APRIL, 1865.

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OF THE

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FOR THE 111TH SESSION, 1864-5.

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EXAMINATION PAPERS

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FINAL EXAMINATIONS OF THE SOCIETY OF ARTS, HELD IN APRIL, 1865.

ARITHMETIC.

THREE HOURS ALLOWED.

1. Find, by Practice, the value of $835\frac{2}{3}$ articles at £2 13s. 4d. each.
2. The price of iron is 16s. 7 $\frac{1}{2}$ d. per cwt., find the cost of 24 tons, 15 cwt., 2 qrs., 14 lbs.
3. Find the sum, in integers, of £3125, 4375s., and 75d.
4. If 2,240 stones, each 9 in. square, will pave a yard, how many stones will be required to pave a yard twice the size, each stone measuring 14 in. by 12?
5. Convert £540 17s. 6d. into decimal currency, £1 being the unit, and then find its simple interest for 3 $\frac{1}{2}$ years at 4 per cent. per annum, expressing the answer both in decimal and ordinary currency.
6. Goods were sold for £225 10s. with a gain of 12 $\frac{1}{2}$ per cent.; what would have been gained or lost per cent. by selling them for £187 10s.? Work by decimal currency.
7. A workman's wages are 1 flo. 3 cents, 4 mills a day, and his expenses are 12s. 6d. a week; what will his savings amount to at the end of a year in common money?
8. Exchange into English decimal coinage 12,687 francs, 50 centimes, the rate of exchange being 25 francs 32 $\frac{1}{2}$ centimes per pound sterling.
9. If a person whose income is £365 a year spend £8 16s. 3d. a week for the first 20 weeks, to what amount must he limit his daily expenditure for the remainder of the year so as to avoid being in debt at the end of it?
10. Find the insurance at 3 per cent. on a house worth £374, so that in case of fire the insurer may receive the value of the house and premium.
11. Transfer £1,500 of 3 per cent. stock at 90 to the 4 per cents. at 75, and find the difference in the annual income.
12. A merchant bought 24 cwt. of sugar at 5 $\frac{1}{2}$ d. per lb., and sold $\frac{1}{3}$ of it at 6 $\frac{1}{2}$ d., $\frac{1}{4}$ of it at 6d., and the remainder at 5 $\frac{1}{4}$ d. per lb., what is his gain per cent.?
13. A tradesman marks his goods with two prices, one for ready money and the other for a year's credit, allowing discount at 5 per cent.; if the credit price is £2 9s., what ought the cash price to be?
14. A has goods worth 30s. which he barter with B at 45s., allowing him 9 months' credit; B rates his exchange at 20s., giving six months' credit. What is the value of B's goods?
15. At a game of skill A can give B 10 points out of 50, and B can give C 10 points out of 50. How many points can A afford to give C out of 50?
16. If oranges can be bought at the rate of 20 a shilling, how many should be sold for £1 8s. to gain 40 per cent.?
17. A, B, and C are partners, A receiving $\frac{2}{5}$ of the profits, B and C sharing the remainder equally. A's in-

come is increased £220 when the profits rise from 8 to 10 per cent. Find the respective capitals invested.

18. A merchant purchases wheat at 71s. 6d. a quarter; at what must he sell it to gain 12 $\frac{1}{2}$ per cent. and allow a purchaser 2 $\frac{1}{2}$ per cent. discount?

19. What half-yearly dividend is due upon an investment of £2,500 in the Three per Cents at 87 $\frac{3}{8}$ after deducting 7d. in the pound for income-tax?

20. If 15 men be necessary to excavate 966 cubic yards in 8 days, working 10 $\frac{1}{2}$ hours daily, how many men would be required to excavate 575 cubic yards in 12 days, working 7 $\frac{1}{2}$ hours daily, 4 extra men being taken on during the last 4 days?

BOOK-KEEPING BY DOUBLE ENTRY.

THREE HOURS ALLOWED.

1. In what does the difference between single entry and double entry consist, and what is the special advantage possessed by the double entry method?

2. What is the distinctive use of the "Journal" in the Italian system of book-keeping by double entry?

3. What should a profit and loss account exhibit?

4. What should a balance sheet exhibit?

5. Journalize and post in proper technical form and language, the following imaginary facts and transactions, and make out from the ledger, a trial balance, a profit and loss account, and a balance-sheet.

John Long and James Rose begin business in partnership on the 1st January, 1865.

John Long's capital was £2,000 in cash, and James Rose's capital £1,500 in cash and £1,000 in wine.

N.B.—The capital and drawings of the partners are subject to interest at 5 per cent. per annum, and the balance of the profit and loss account is divisible thus:—To John Long *one-third*, to James Rose *two-thirds*.

1865.

Jan. 3. Bought of Tom Styles, wine, duty paid	£450	0	0
„ Accepted Tom Styles draft @ two months date	450	0	0
5. Lent John Nokes cash	300	0	0
7. Sold to W. Box, wine	800	0	0
„ Sold to H. Potts, wine	250	0	0
„ Received of W. Box, cash on account	600	0	0
8. Sold to S. Vix, wine	120	0	0
„ Paid cash for office furniture and fixtures	105	0	0
9. Received of W. Box, his acceptance @ six months	205	0	0
„ Charge W. Box with interest, six months, on £200	5	0	0
12. Shipped on own account and risk to Bombay, wine invoiced at	330	0	0
13. Bought wine of J. Styles	700	0	0
„ Paid cash to J. Styles on account ...	500	0	0

15. Cash drawn out by James Rose	400	0	0
„ Do. do. by John Long	100	0	0
„ Bought of C. Aggs, wine	830	0	0
16. Received cash, advance on the above shipment to Bombay	140	0	0
„ Bought wine for ready money, and paid cash	1,150	9	0
„ Accepted C. Aggs draft at three months date	500	0	0
Jan. 18. Sold wine to J. Nokes	£625	0	0
„ Charge interest to J. Nokes	7	10	0
„ Received of J. Nokes his acceptance on account	732	10	0
„ Advanced for petty cash	20	0	0
20. Sold wine to J. Nokes	270	0	0
„ „ „ J. Dodd	860	0	0
23. „ „ „ R. Kell	400	0	0
„ Paid trade charges out of petty cash	8	6	8
24. Bought wine of N. Scott	125	0	0
26. Received of J. Nokes his acceptances S. Dodd	100	0	0
„ „ „ S. Dodd	300	0	0
28. Discounted with O. G. & Co. J. Nokes' acceptance for	732	10	0
„ Received cash of O. G. & Co.	705	5	0
„ Discount charged by O. G. & Co.	27	5	0
30. Paid to N. Scott, W. Box's accep- tance	205	0	0
31. Stock of wine on hand at cost	950	0	0
„ Interest on amount drawn out by John Long	0	3	4
„ Interest on John Long's capital	8	6	6
„ Interest on amount drawn out by James Rose	0	13	4
„ Interest on James Rose's capital	10	8	4
„ Rent due to A. Bone	18	10	0
„ Salary due to T. Fox	25	0	0
„ Trade charges paid out of petty cash	9	3	0

ALGEBRA.

THREE HOURS ALLOWED.

A.

1. If n is any integer, show that $x^n - a^n$ will divide out by $x - a$, and find the value of the quotient.
2. If $A_n - A_{n-1} + A_{n-2} + \dots + A_1 + A_0 = 0$ prove that $A_n x^n + A_{n-1} x^{n-1} + \dots + A_1 x + A_0$ contains the factor $x - a$.
3. Find the value of the continued product of $a + b + c$; $a + b - c$; $a - b + c$; $a - b - c$; and account for the result remaining unchanged when any two letters in it are interchanged, and also for it containing no odd power of a , b , or c .

4. Reduce the fraction $\frac{\frac{a+b}{c+d} + \frac{a-b}{c-d}}{\frac{a+b}{c-d} + \frac{a-b}{c+d}}$ to its simplest form.

5. The provisions of a fort ran out in 30 weeks; it was originally victualled for 60 weeks, but at the end of eight weeks its strength was doubled, and six weeks later 750, fresh men were thrown in. How many men were in the fort at first?

6. Find the square of $\sqrt{1+c} + \sqrt{1-c}$ and extract the square root of $1 - (1 - c^2)^{\frac{1}{3}}$.

7. If $a + b$, $a + c$, $b + c$, are in harmonic progression, show that a^2 , b^2 , c^2 are in arithmetical progression.

$$8. \text{ Solve the equations } \begin{cases} \frac{x^2}{y} + \frac{y^2}{x} = 18 \\ x + y = 12 \end{cases}$$

B.

9. Express 1865 in the ternary scale of notation. Also

in a scale employing only the symbols of zero and plus or minus unity (denoted by 1, $\bar{1}$ respectively), express the value of 50.

10. Extract the cube root of 990 in ascending powers of $\frac{1}{100}$ by the binomial theorem, and apply your result to find its value to seven places of decimals.

11. Five sets of three-volumed novels are arranged along a book-shelf; in how many different ways can they be *intermixed*, taking care that the second volume of any one set is always to be found between the first and last volumes of the same set.

GEOMETRY.

THREE HOURS ALLOWED.

To obtain a First-class Certificate, at least six problems and four propositions must be correctly done; to obtain a Second-class, at least four problems and eight propositions.

1. All the angles made by any number of lines meeting in one point are together equal to four right angles.
2. If two triangles have two sides of the one equal to two sides of the other, each to each, but the angle contained by the two sides of one of them greater than the angle contained by the two sides equal to them of the other, the base of that which has the greater angle shall be greater than the base of the other.
3. Describe a parallelogram that shall be equal to a given triangle, and have one of its angles equal to a given rectilineal angle.
4. If a straight line be bisected and produced to any point, the rectangle contained by the whole line thus produced, and the part of it produced, together with the square on half the line bisected, is equal to the square on the straight line which is made up of the half and the part produced.
5. Draw a straight line from a given point either without or in the circumference, which shall touch a given circle.
6. In a circle the angle in a semi-circle is a right angle; and the angle in a segment, greater than a semi-circle, is less than a right angle; and the angle in a segment less than a semi-circle is greater than a right angle.
7. Describe a circle about a given square.
8. If the sides of two triangles about each of their angles be proportionals, the triangles shall be equiangular to one another, and shall have those angles equal which are opposite to the homologous sides.
9. Similar polygons may be divided into the same number of similar triangles, having the same ratio to one another that the polygons have.
10. If the vertical angle of a triangle be bisected by a straight line which also cuts the base, the rectangle contained by the sides of the triangle is equal to the rectangle contained by the segments of the base together with the square of the line which bisects the angle.
11. If two straight lines be at right angles to the same plane they shall be parallel to one another.
12. If two parallel planes be cut by another plane their common sections with it are parallel.

PROBLEMS.

1. Construct a right-angled triangle, having given the perimeter and one angle.
2. Bisect a given quadrilateral by a straight line drawn through a given angular point.
3. In any quadrilateral the squares on the diagonals are together equal to twice the sum of the squares on the straight lines joining the middle points of opposite sides.
4. Circles are drawn touching a fixed straight line at a fixed point; show that the tangents at the points where they cut a parallel fixed line, all touch a fixed circle.
5. Given one angle of a triangle, the side opposite to it, and the sum of the other two sides—construct the triangle.

6. Divide a given arc of a circle into two parts, so that the chords of these parts shall be to each other in a given ratio.

7. Trisect a given triangle by lines drawn from a given point in one of its sides.

8. Describe a circle which shall touch a given straight line at a given point, and bisect the circumference of a given circle.

9. Point out how, with a card and pair of scissors, ocular proof may be given of any of these propositions:—

- (1) The angles of a triangle are together equal to two right angles.
- (2) Parallelograms upon the same base, and between the same parallels, are equal to one another.
- (3) The squares on the sides containing the right angle of a right-angled triangle are equal to the square on the other side.
- (4) If a straight line be divided into two equal and also into unequal parts, the squares on the two unequal parts are together double of the square on half the line, and of the square on the line between the points of section.

MENSURATION.

THREE HOURS ALLOWED.

1. Prove that a rain-fall of an inch gives about 100 tons to the acre. What would a fall of a centimetre give to the hectare?

2. Show how to measure a given parallelogram.

The perpendicular distances between the opposite sides of a parallelogram are to be two and three inches; find the area of the least parallelogram which satisfies this condition; and construct another which is twice this area, and satisfies the same condition.

3. Explain the construction and use of the *diagonal scale*.

4. Find the area of a right angled triangle, one side of which is 15 inches, and the hypotenuse $3\frac{1}{2}$ feet.

5. A rectangle is 8ft. 6in. long, and 4ft. 9in. broad, find its cost at 1s. 6d. per foot, by duodecimals.

6. Draw a plan, and find the area of a field from the following notes:—

444 to A
132 264
From C on R
336 to C
From B on R
564 to B
From A

7. Prove that the perimeter of a square is less than the perimeter of a rectangle of the same area.

Find the least number of hurdles, each 2 yards long, which will enclose an acre of land of rectangular shape.

8. Find the cost, at £6 15s. per rod, of the outer walls of a house 35ft. wide, 28ft. 6in. deep, and 35ft. to the roof, there being a gable at each end, rising 32 courses of bricks, reckoning 4 courses to a foot, the first 12ft. being 2 bricks thick, the next 15 being $1\frac{1}{2}$, and the rest 1 brick thick.

9. Find the area of a circle whose diameter is 113 inches, and circumference 355.

10. Find the diameter of a 600-pound cannon ball whose specific gravity is 7.2.

11. The curved surface of a circular cylinder is 10ft., the areas of its two ends the same as that of a circle 10in. in diameter: find its volume, and the weight of the water which it will contain.

12. Prove that the volume of any pyramid is equal to one-third of its base into the height.

TRIGONOMETRY.

THREE HOURS ALLOWED.

1. Find the circular measure of $29^{\circ} 4'$ French and of $1^{\circ} 50' 9''.6$ English.

2. Prove that $\text{Sin. } 2a = \frac{2 \tan. a}{1 + \tan. a^2}$

And that $\text{Cot. } (a-b) = \frac{\text{Cot. } a \text{ Cot. } b + 1}{\text{Cot. } b - \text{Cot. } a}$

3. If A B C be a triangle, sides a b c , then $c^2 = a^2 + b^2 - 2 ab \text{ Cos. } C$. Adapt this to logarithmic computation.

4. A B C is a triangle, and A D meeting the base in D divides angle A into two angles, m and n , so that $\frac{\text{Sin. } m}{\text{Sin. } n} = \frac{c}{b}$

Prove that $\text{Cot. } m - \text{Cot. } n = \text{Cot. } C - \text{Cot. } B$; the angle B A D = m .

5. Prove that—

$$(1) \frac{\text{Sin. } (2a+b)}{\text{Sin. } a} = 2 \text{ Cos. } (a+b) + \frac{\text{Sin. } b}{\text{Sin. } a}$$

$$(2) \text{Cosec. } 2a + \text{Cot. } 4a = \text{Cot. } a - \text{Cosec. } 4a.$$

6. Find a when

$$(1) \text{Sin. } 5a = 16 (\text{Sin. } a)^5$$

$$(2) \text{Sin. } a + \text{Sin. } 2a + \text{Sin. } 3a + \text{Sin. } 4a = 0.$$

$$(3) \text{Cos. } a - \text{Cos. } 2a = \text{Sin. } 3a.$$

7. If A B C be the angles of a triangle—

$$(1) a (b \text{ Cos. } C - c \text{ Cos. } B) = b^2 - c^2$$

$$(2) \frac{\tan. A}{\tan. B} + \frac{\tan. B}{\tan. C} + \frac{\tan. C}{\tan. A} + \frac{\tan. C}{\tan. B} + \frac{\tan. B}{\tan. A} + \frac{\tan. A}{\tan. C} = \text{Sec. } A \text{ Sec. } B \text{ Sec. } C - 2.$$

8. In a right-angled triangle $C = 90^{\circ}$: $c = 7584$: $b = 3000$; find B, when

$$\log. 7584 = .8798983 : \log. 2 = .30103$$

$$\log. \sin. 34^{\circ} 59' = 9.7584105 : \text{diff. for } 1' = .0001805$$

9. A D and B E are perpendiculars from the angles A and B of the triangle A B C on the sides opposite. Show that D E = $c \text{ Cos. } C$.

10. The radius of the circle inscribed in a triangle,

$$= a \text{ Sin. } \frac{B}{2} \text{ Sin. } \frac{C}{2} \text{ Sec. } \frac{A}{2}$$

11. Sum the following series to infinity—

$$\text{Sin. } a + \frac{1}{1.2} \text{ Sin. } 2a + \frac{1}{2.3} \text{ Sin. } 3a, \&c.$$

12. The elevation of Cader Idris, at a point in the valley near Dolgelly, is $\text{Cot. } .16$; at Ty Gwyn, $3\frac{1}{2}$ miles down the valley, it has the same elevation; at a point half-way between, its elevation is $\text{Cot. } .15$. Show that its height above the valley is $\frac{7}{4\sqrt{11}}$ miles.

13. In a spherical triangle find the sine of the angle in terms of the sides.

14. Find the area (s) of a spherical triangle in terms of its angles.

15. And then show that—

$$\text{Cot. } \frac{s}{2} = \text{Cot. } \frac{a}{2} \text{ Cot. } \frac{b}{2} \text{ Cosec. } C + \text{Cot. } C$$

16. Given B, a and b , and $\text{Cot. } \theta = \text{Cos. } b \tan. a$,

$$\text{Prove that } \text{Sin. } (c + \theta) = \text{Cos. } b \text{ Sin. } \theta \text{ Sec. } a$$

CONIC SECTIONS.

THREE HOURS ALLOWED.

SECTION I.—GEOMETRICAL CONICS.

1. Define a cone, a parabola, the focus of a parabola, the diameter of a conic. Show that in a parabola the sub-normal is constant, and the sub-tangent is double of the abscissa.

2. In the parabola prove that $\text{NP}^2 = 4\text{AS} \times \text{AN}$.

3. Tangents which meet on the directrix of a parabola are at right angles to each other; and the line which joins the points of contact passes through the focus.

4. Define tangent of an ellipse, and prove that the tangent of an ellipse is equally inclined to the focal distances of the point of contact.

5. The normal at a point P of an ellipse meets the major axis in G and the minor axis in G'; prove that

$$PG : PG' :: CB^2 : CA^2$$

6. The rectangles contained by the segments of two intersecting chords of a central conic are as the squares of the parallel semi-diameters.

7. If a perpendicular is drawn from the focus of a hyperbola on a tangent, the point of intersection lies in the auxiliary circle.

8. Prove, by Projection or otherwise, that in the hyperbola

$$NP^2 : AN \times NA' :: CB^2 : CA^2.$$

9. Define asymptotes of a hyperbola; and construct them geometrically when the hyperbola is given.

10. If an ellipse is defined as the section of a cone by a plane, find, by geometrical construction, the centre, foci, directrices.

11. If a circle is projected into a central conic, show that the diameters which are parallel to a pair of supplemental chords are conjugate to each other.

SECTION II.—ANALYTICAL CONICS.

12. Determine the equations to the straight lines passing through the origin, and making an angle of 45° with the line $ax + by + c = 0$.

13. Find the equations to the internal and external bisectors of the vertical angle of a triangle; and show that the base is divided internally and externally by these lines into parts, the ratio of which is the same as that of the sides of the triangle.

14. What is the equation to the circle, passing through the origin and making given intercepts on the co-ordinate axes? find its radius and the position of its centre.

15. Define pole and polar of a circle. If the polar of the circle, $x^2 + y^2 = r^2$, is $Ax + By + C = 0$, what is the place of the pole?

16. The equation to an ellipse being $a^2y^2 + b^2x^2 = a^2b^2$, find the lengths of the focal distances; and hence prove that $SP \times HP = CD^2$; that is, the rectangle contained by the focal distances is equal to the square on the corresponding conjugate semi-diameter.

17. Place analytically the theorems contained in 1, 3, 5, 7 of the preceding section.

18. Show that the equation $x^3 + y^3 = a^3$ represents a parabola, and indicate by a diagram its position relatively to the co-ordinate axes.

19. Determine the equations of the principal axes and of the asymptotes of the hyperbola

$$3x^2 + 2xy - y^2 + 4 = 0.$$

NAVIGATION AND NAUTICAL ASTRONOMY.

THREE HOURS ALLOWED.

Not more than one question to be answered in each section.

I.

1. Prove that the sides and angles of the polar triangle of a spherical triangle are respectively the supplements of the angles and sides of the primitive triangle.

2. The sides of the angles of a spherical triangle are proportional to the sines of the opposite sides.

3. Prove Napier's analogies.

II.

1. State Napier's rules for the solution of a right-angled triangle, and prove them when one of the sides is taken for the middle part.

2. Perpendiculars are drawn from the angles A, B, C of any triangle, meeting the opposite sides in D, E, F respectively; show that $\tan. BD \cdot \tan. CE \cdot \tan. AF = \tan. DC \cdot \tan. EA \cdot \tan. FB$.

3. Having given two angles and side opposite to one of them, solve the triangle.

III.

1. Required the compass course and distance from A to B, given

Lat. A $7^\circ 18' N.$ Variation $1\frac{1}{2}$ pts. E. long. A $2^\circ 10' W.$
 " B $2^\circ 5' N.$ Deviation $2^\circ 45' E.$ " B $2^\circ 10' W.$

2. A ship in lat. $37^\circ 5' N.$, long. $18^\circ 53' W.$, sailed as follows:—

K.10ths.	Courses.	Wind.	Leeway.	Variation.	Deviation.
59 5	S.S.W.	W.b.S.	Pts. $\frac{3}{4}$	Pts. $1\frac{1}{2}$ W.	$6^\circ W.$
53 6	N.W.	N.b.E.	" $\frac{1}{2}$	" "	$4^\circ 50' W.$
62 0	E.b.S.	N.N.E.	" 1	" "	$7^\circ 15' E.$

Required the lat. and long. in.

3. A ship sails in a great circle from a place lat. $18^\circ 10' N.$, long. $5^\circ 30' W.$, to another, lat. $25^\circ 27' N.$, long. $16^\circ 10' W.$ Find the lat. and long. of the vertex.

IV.

1. Dec. 1, 1865, the observed mer. alt. of η Draconis under the North Pole was $30^\circ 50' 30''$, the index error was $-1' 45''$, and the height of the eye above the sea was 19 feet. Required the latitude.

2. March 5th, 1865, at 4h. 59m. p.m. in lat. $40^\circ 48' N.$, long. $133^\circ 30'$ the obs. alt. of sun's L.L. was $9^\circ 46' 0''$ when she bore by compass S. $83^\circ 15' W.$ (ship's head S.S.W., Deviation $5^\circ W.$) Index error $+1' 30''$ and the height of the eye 20 feet. Required the variation.

V.

1. Prove that $\tan. \text{course} = \frac{\text{Diff. long.}}{\text{Mer. diff. lat.}}$

Construct the figure for the following example—Given diff. long. $= 171' E.$; mer. diff. lat. $= 157' N.$, to find the course.

2. Explain a Mercator's chart, and show how to find the latitude and longitude of a place on it.

3. Show how to find the latitude and longitude of the vertex when a ship sails in a great circle from one point to another.

VI.

1. June 22, in lat. by account $20^\circ 16' N.$, long. $110^\circ 10' E.$, the following observations were made:—

Mean time nearly.	Chronometer.	Obs. alt.	Sun's L.L.	True bearing.
9h. 30m. a.m.	2h. 39' 21"	54° 52' 50"	E.b.N.	
2h. 13m. p.m.	7h. 22' 19"	58° 46' 50"	W.b.N.	

The run of the ship in the interval was N.b.W. 28 miles, the index error was $+1' 15''$, and the height of the eye 16 feet. Required the latitude at the time of making the second observation.

2. Feb. 1, 1865, at 4h. 46m. p.m. in latitude $49^\circ 10' N.$, long. $4^\circ 20' W.$, the following observations were made:—

Obs. alt. Venus.	Obs. alt. Moon's L.L.	Obs. dist. NL.
West of Meridian.		
$36^\circ 6' 40''$	$50^\circ 35' 0''$	$27^\circ 20' 0''$

Index error $-1' 15''$ $+1' 35''$ $-1' 15''$

The height of the eye was 17 feet. Required the longitude.

VII.

1. Show that the hour angle of a heavenly body $= R. A. \text{ mean sun} + \text{ship mean time} - R. A. \text{ heavenly body}.$

2. Prove the rule for finding the variation of the compass by an observed amplitude of the sun.

3. Prove that the error in the hour angle is least for a given error in the altitude when the sun is on the prime vertical.

VIII.

1. The arc of a sextant is divided into twice the num-

ber of degrees due to its length; explain by a figure the reason for this.

2. Describe the azimuth compass, and show how it is employed to observe the bearing of the sun.

3. Explain accurately all the ways you know by which the index error of a sextant may be obtained.

ASTRONOMY.

THREE HOURS ALLOWED.

1. Define a day; a solar day; a mean astronomical day; a lunar day; and a sidereal day.

2. State the difference between the civil, or common method of reckoning time, and the astronomical method.

3. Give the rule for determining astronomical time from civil time.

4. What is the equation of time, and for what purpose is it used.

5. Does the equation of time ever vanish, and if so when?

6. Does the equation of time vary from year to year, and if so why?

7. State what methods you know to determine mean time by observation.

8. Define sidereal time at mean noon.

9. The sidereal time at mean noon at Greenwich on January 1st, 1866, will be 18h. 43m. 38.3s., what will be the mean solar time corresponding to January 1st, 21h. 44m. 7.9s. sidereal time?

10. Convert 6h. Greenwich mean time on January 1st, 1866, into sidereal time for the same meridian.

11. Give an expression for finding the length of the day at any place.

12. What is the latitude of those places where the sun does not set for 24 hours on the 21st of June; and also of those places where the sun does not set for 24 hours on the 21st of December.

13. When is the sun due east on a given day?

14. Define moon's semi-diameter, and state when it is used, and for what purposes.

15. Define moon's horizontal parallax, state when and how it is used, and for what purpose.

16. The right ascension of the sun on

	h.	m.	s.
January 1, 1866, at mean noon is	18	47	31
" 2, " " "	is	18	51 55
" 3, " " "	is	18	56 20

What is the right ascension of the sun at Greenwich on Jan. 1st, 18h. mean time?

17. What is the right ascension of the sun on January 1, 1866, at 6h. Venice mean time, the longitude of Venice being $12^{\circ} 21' 21''$ east of Greenwich?

18. Explain Kepler's laws.

19. Mention what is known of variable periodic stars.

20. Mention what is known of the prismatic spectra of stars and of planetary nebulae.

21. Mention what you know of astronomical instruments, particularly the transit, mural-circle, transit-circle, and equatorial, with their uses.

22. Explain the use of the method of differences in the interpolation of series.

	h.	m.	s.
23. Given right ascen. 2 57 50.74 on 1st day at mean midnight			
2 56 53.87 on 2nd "			
2 55 58.06 on 3rd "			

Required accurately, using second differences, the right ascension on the 2nd day at 11h. 39m. mean time.

24. Given, the sun's declination at mean noon on

	h.	m.	s.
Jan. 19, 1866=	23	26	14.8
" 20, " =	23	26	56.8
" 21, " =	23	27	14.0
" 22, " =	23	27	6.4

Required, the exact declination on the 21st day at 4h. 33m. mean solar time.

PRINCIPLES OF MECHANICS.

THREE HOURS ALLOWED.

1. State, without proof, the fundamental propositions which belong to statics, dynamics, and hydrostatics respectively.

2. Find the conditions of equilibrium of any number of forces acting in any direction on a material particle. Ex.: Three ropes, attached by a ring to a heavy block, are each stretched, at right angles to each other, by a weight of 50 lbs. What weight should be attached to a single rope that it may produce an equal effect upon the block, and how must it be placed with regard to the other three ropes?

3. Describe the common steelyard, and show how to graduate it. Ex.: A steelyard, having a weight of 10 lbs. at one end, and a scale-pan weighing 6 lbs. at the other end, is used as a balance by moving the rod backwards and forwards over a fulcrum, on which the whole rests; neglecting the weight of the steelyard, show how to graduate it.

4. Define the moment of a force about a point; show how it may be geometrically represented, and hence show that the sum of the moments of two non-parallel forces about a point in their plane equals the moment of their resultant about the same point. Show that the above statement is true if the forces be parallel. Ex.: Two parallel forces, 8 and 9, act at a distance of 17 inches from each other; what is the moment of their resultant about a point 12 inches distant from that force which is nearest to it, an inch being taken as the unit of length?

5. How do we obtain a measurement of variable velocity at any particular instant? What is the law of the velocity of freely falling bodies? Ex.: A body is projected downwards with a velocity of 80 feet per second; determine the velocity at the end of five seconds; if instead it were projected upwards, when would its velocity cease?

6. A body is acted upon continually by a given pressure; show what acceleration is given to its motion. Ex.: A body weighing 30 lbs. slides along a smooth horizontal plane under a constant pressure of 15 lbs.; determine (1) the velocity it acquires every second; (2) the velocity at the end of 5 seconds; (3) the space passed over in 5 seconds. What would be these results if the plane were rough, and the co-efficient of friction were .2?

7. A body slides down a smooth curve; state and prove what velocity it will acquire at the end of the curve. Ex.: A stone is tied to the end of a string of 10 feet in length, and describes a vertical circle of which the string is the radius; if at the highest point it move at the rate of 25 feet per second, what will be its velocity at the lowest point?

8. What is a cycloid? Show that the time of oscillation of a particle moving in a cycloid is independent of the extent of the arc of oscillation. Ex.: If the radius of the generating circle be 10 feet, what is the time of an oscillation?

9. What is the fundamental principle, known as D'Alembert's principle, employed in rigid dynamics? Ex.: A sphere has a spherical eccentric cavity filled with water, and rolls on a rough horizontal plane; find its motion.

10. What are the differences between elastic and non-elastic fluids? Give examples of each.

11. Prove that the pressure at any point below the surface of a uniform fluid which is at rest under gravity alone varies with the depth. What is the pressure tending to drive in the cork of an empty bottle sunk to the depth of 300 fathoms in seawater (S.G. = 1.028), when the barometer is 30 inches (S.G. of mercury = 13.6), the area of the cork being a square inch? N.B.—A cubic foot of distilled water weighs 1,000 oz.

12. Describe a common hydrostatic balance and show how by means of it to find the S.G. of a solid body—(1) heavier; (2) lighter than distilled water, the latter being

used as the unit of measurement. Ex.: A crystal of saltpetre weighs 19 grains; when covered with wax (S.G. = .95) the whole weighs 43 grains in air and 8 grains in water; find the S.G. of the saltpetre.

13. Describe a condenser, and find the corresponding densities of the air before and after a given number of strokes.

14. Describe the essential parts of a double-acting condensing steam-engine. State what you know of the latest mechanical improvements applied to this kind of engine.

PRACTICAL MECHANICS.

THREE HOURS ALLOWED.

1. In toothed-wheel work what is meant by the *pitch circle* and the *pitch of a tooth*; what is the diameter of the pitch circle of a wheel having 88 teeth of $2\frac{1}{2}$ inch pitch?

2. Explain the contrivance of the *crank and connecting rod*, for converting circular into reciprocating motion, and show that the movement which would result from a crank with an infinite connecting rod may be imitated by the use of an *eccentric circle*.

3. Explain the following mechanical contrivances; (1) the anchor escapement, (2) the mangle wheel, (3) the Geneva stop, (4) the fusee.

4. A wheel (A) is fixed in space; an arm carrying two other wheels (B) and (C), is capable of revolving about an axis through the centre of (A), and it is further arranged that the three wheels shall gear together, so as to form a train (A), (B), (C); what will be the motion imparted to (C) by the revolution of the arm, (1) when (C) is equal to (A), and (2) when it contains half as many teeth as (A); explain your answer, and point out the value of the first combination in machinery for twisting strands into rope.

5. Explain the *parallel motion* of a beam-engine.

6. Upon what principle is machinery for drilling made self-acting? Select an example which illustrates your statement.

7. Describe some arrangement which would serve to indicate the number of revolutions made by a carriage wheel in a given time.

8. Explain Newcomen's atmospheric engine, and show how it was altered and improved by Watt.

9. Why is it advantageous to work a steam-engine expansively; if steam of a given pressure be cut off when the piston has described one-fourth of its stroke, find the work done in the cylinder. What is the lap of a slide-valve, and what effect does it produce in the working of the engine?

10. Sketch a double-beat valve, and explain its action.

11. Explain any form of gauge for measuring the pressure of steam in a boiler.

12. Describe the general arrangement of a locomotive engine and boiler, and explain Stephenson's *link motion* for reversing the engine.

ELECTRICITY AND MAGNETISM.

THREE HOURS ALLOWED.

1. Describe the best construction of a mariner's compass. How are the needles best arranged, and why?

2. How have the diurnal changes in the earth's magnetism been accounted for?

3. Explain experimentally the phenomena of diamagnetism.

4. State the theory of electricity which you consider most in accordance with the present state of knowledge, and mention some experimental illustrations.

5. Distinguish between an electrometer and an electroscope, and describe the condensing electroscope.

6. Explain the conditions of efficiency in a lightning conductor.

7. In what respects does the electricity evolved from a machine differ in quality from that of a battery, and how may they be shown to be identical?

8. What is a *so-called* astatic needle, and what position will it assume when the two needles are exactly equal in force?

9. Explain the construction and use of a tangent-galvanometer.

10. Explain the cause of the rotation of a current round a magnet, or *vice versa*.

11. Describe the construction of any magneto-electric telegraph.

12. Explain the construction of a submarine cable, and the method of testing its insulation.

13. How is an induction-coil machine constructed, and by what special apparatus may the shocks be intensified?

14. Explain the process of electroplating.

15. By what means can the current be most economically produced for electro-metallurgy on the large scale?

16. What phenomena result from the transmission of a current through a living compound nerve?

17. What electric phenomena are manifested by portions of nerve and muscle of a recently killed animal?

18. What is the peculiar character of thermo-electric currents, and by what means can they be most readily produced?

LIGHT AND HEAT.

THREE HOURS ALLOWED.

GEOMETRICAL OPTICS.

1. Give the definitions of a beam of light, a ray of light, and a pencil of rays. Trace the visual pencil, or the pencil of rays by which the image is seen, when an eye in a given position sees the image of an object which is formed by a *plane mirror*; showing the form and position of the image from the law of the reflection of light, and stating whether the image which is seen is real or virtual.

2. Show how the image of an object is formed by a *concave* spherical mirror, both when the object is near the mirror and when it is distant. Show that the image of an object formed by a *concave* mirror is sometimes real and sometimes virtual, and show the circumstances in each case. Show how a combination of a concave mirror, a plane mirror, and an eye-lens constitute the Newtonian telescope, and show how the magnifying power is found.

3. Show how the *refraction* of light at a *convex* spherical surface of a dense refracting medium forms an image of a distant object within the medium. Apply this discussion to explain the formation of an image upon the retina of the eye, supposed in the first instance to be of a homogeneous structure. What discussions have arisen to explain why we see objects erect, when the image formed upon the retina is inverted?

4. Explain what is meant by an *achromatic* lens; and show how the achromatism is produced. State the advantages possessed by achromatic telescopes and microscopes over the simple forms of these instruments.

PHYSICAL OPTICS.

5. Explain what is meant by a beam of *plane polarized* light, and show the various methods by which such beams can be obtained. Explain the modes of testing the polarization. What is the state of the polarization of the two rays, which, originating in a ray of common light, have traversed a double refracting crystal?

6. Explain what is meant by the colours of *thin plates*, and show how the colours of the soap bubble, and of *thin films* of refracting substances generally, are explained on the doctrine of the interference of light. Describe some cases which occur in common experience where such an explanation will apply.

7. Describe the appearances seen when we place a *hair of the head* before the pupil of the eye, and look towards a distant lighted candle; these appearances being more distinct when we look through a pin-hole in a card, or a narrow slit parallel to the hair. Give the explanation of the phenomena which are seen.

8. Show the arrangements which are necessary in the polarizing microscope, and state how the phenomena which are seen in the field of view arise. Give some examples of objects which are proper for the polarizing microscope.

HEAT.

9. Give the distinction between the *temperature* and the *latent heat* of a body. If steam, and the water from which it arises, are of the same temperature, explain what amount of heat (or, better, of caloric as the cause of heat) has been required to change the water into steam. When the steam is condensed into water again, what amount of heat does it give out?

10. Describe the construction and graduation of the common *mercurial* thermometer; and show how to compare the different scales of degrees which have been used. When the temperature is 80° in England, what would it be called in France?

11. State the ordinary law of the *increase of volume* of the gases under constant pressure for increase of temperature. Does the same law apply to super-heated steam when removed from contact of the water from which it is produced; and to the vapours of the liquids generally, in similar circumstances?

12. Explain the *principle* of the construction of the double-acting condensing steam engine; and show how the communicating and abstracting of heat produces the mechanical force which is developed.

CHEMISTRY.

THREE HOURS ALLOWED.

No candidate is allowed to answer more than three questions in each division.

FIRST DIVISION.

1. 100 cubic centimetres of air (6.10271 cubic inches) are mixed with 50 cubic centimetres of hydrogen at 15° C. What will be the volume of the residual mixture after explosion, at the same temperature and pressure?

2. Describe the construction and working of an apparatus for the preparation of pure and dry hydrogen. Explain by symbols the chemical changes which occur in the process.

3. How is ammonia obtained from crude coal gas? Describe and explain the chief reactions of ammonia.

4. How is marsh-gas obtained in a state of purity? How much heavier is it than hydrogen? How can you distinguish and separate it from olefant gas?

5. Describe and explain the action of chlorine on a concentrated solution of potassic carbonate, also its action on slaked lime.

6. How would you prepare pure silica from an insoluble silicate such as felspar?

SECOND DIVISION.

1. An alloy of antimony and lead is given. How would you prepare pure metallic antimony from it?

2. A sample of copper is suspected to contain arsenic. How would you proceed in order to decide whether arsenic is contained in it?

3. Describe the action of sulphuretted hydrogen on aqueous solutions of the following compounds separately, viz., antimonious acid, corrosive sublimate, chromic acid, ferric chloride (susquechloride of iron), supposing that each of the solutions contains free hydrochloric acid. Explain the action in each case by an equation.

4. Explain the manufacture of white lead.

5. How is aluminium prepared? What alloy of aluminium is chiefly made?

6. How is caustic potash usually prepared? What are its chief impurities? How can the alkali be obtained pure?

THIRD DIVISION.

1. How is vinegar usually made? how purified? Describe the compounds of acetic acid and lead, giving their formula.

2. Describe and explain the process of etherification, giving the formula of the substances which take part in it.

3. What decomposition does benzoate of lime undergo when subjected to dry distillation? What is the decomposition when it is distilled with hydrate of lime?

4. How can pure uric acid be obtained from guano?

5. How would you test for cane sugar in the sap of a plant?

6. Describe the formation and properties of some compounds of metals with alcohol radicals, and show in what manner their constitution decides the atomic weights of the metals contained in them.

MINING AND METALLURGY.

THREE HOURS ALLOWED.

1. Describe the apparatus most commonly employed for the treatment of auriferous quartz.

2. Which is the principal ore of antimony, and how is metallic antimony commercially obtained from it?

3. How is coke manufactured from small coal, and what are the conditions necessary for the production of coke of good quality?

4. Name the principal varieties of ironstone employed in the United Kingdom, and state from what sources they are severally obtained.

5. How does black oxide of manganese usually occur, and for what purposes is it chiefly employed?

6. Describe in outline the metallurgical treatment of the copper-shales of Mansfeldt.

7. How would you estimate by assay the amount of lead and silver contained in a sample of ordinary lead ore?

8. Sketch and describe the stove generally employed for heating the blast of iron-furnaces.

9. Describe the crushing-mill made use of in Cornwall for the preparation of copper ores.

10. What are the essential characteristics of a good fire-clay?

11. What is Kaolin, where is it found, and how is it prepared for market?

12. Name the various ores of zinc, and state their several compositions.

BOTANY.

THREE HOURS ALLOWED.

The Candidate is expected to answer correctly three questions in Section I. and six questions in Section II., including descriptions of at least two of the fresh specimens. Nos. 8, 9, and 10 each stand for an answer.

SECTION I.—VEGETABLE PHYSIOLOGY.

1. Describe the structure and function of *roots*.

2. Upon what structural and physiological conditions does the success of a *graft* depend?

3. What are *hybrids*? What are their characteristic peculiarities?

4. Describe the structure and function of *pollen*. Name three British genera, belonging to different natural orders, in which its structure is very exceptional.

5. What organs are frequently specially modified in *climbing* plants.

6. Describe the probable course of the *ascending* and *descending sap* in an apple-tree.

SECTION II.—PRACTICAL BOTANY.

1. Name six *fruits* commonly cultivated in Britain, which are free from adhesion (*superior*), and six which are adherent (*inferior*), indicating which are *apocarpous* and which *syncarpous*.

2. Describe the principal modifications of the fruit in British genera of *Cruciferae*.

3. Give the principal distinguishing characters of the four *cereals* most largely grown in Britain.

4. Describe the structure of the flower and fruit of the (1) *Chestnut* and (2) *Horse-Chestnut*.

5. What is meant by the term *anatropous*?

6. Distinguish *Gramineae* from *Cyperaceae*.

7. Name the *natural order* to which the plants marked A, B, and C, respectively belong, with *reasons* for your opinion.

8, 9, and 10. Describe the three plants marked A, B, and C, in the proper sequence of their organs, and in accordance with the examples given in Lindley's "Descriptive Botany" and Oliver's "Lessons" (Appendix).

AGRICULTURE.

THREE HOURS ALLOWED.

I.

1. What are the principal means at our command for the improvement of light and heavy soils respectively?

2. State the practice and theory of the application of lime to the land—the uses it is believed to serve in the soil—the several modes (including quantities and times) of applying it—the results which are expected from its application.

3. State the purposes served by the plough, the harrow, the roller, and the grubber or cultivator upon the farm.

II.

4. Give a detailed account of the cultivation of the wheat crop after clover and beans respectively; and describe half-a-dozen good sorts.

5. Enumerate the operations, from the previous corn stubble to the folding of sheep upon the crop, included in the cultivation of the turnip crop; and state the probable cost of each.

6. State the proper application (as regards quantity, time of year, and crop) of farm-yard manure, and of such artificial and imported manures as you may think it necessary to bring on a 400-acre farm of light soil cultivated on the four-field rotation of crops.

III.

7. What is the annual cost of working a pair of horses on a farm? specifying quantities and cost of food, wages of man, blacksmith's bill, and the other charges which enter into the account.

8. Describe the year's management of a breeding flock month by month.

9. How much turnips, mangold wurzel, hay, straw, and bought food (oil cake, meal, &c.) will a score of oxen, costing, say £18 a piece, brought home on October 1, in a fit condition to fatten during winter, have consumed by March 1, and what should they then be worth?

ANIMAL PHYSIOLOGY.

THREE HOURS ALLOWED.

1. Describe the general structure of a long bone, supposed to be recently taken from the living body. Then give an account of the microscopic characters of the osseous tissue, especially noticing any structural arrangements which appear adapted to serve in the nutrition of the bone.

2. Give an outline of the physiological uses of the blood, and mention the constituent parts of that fluid which are concerned in each chief office.

3. What is meant by the "pancreas," where is it situated, what is its purpose or use in the living animal economy, and in what manner does it accomplish that purpose?

4. Give the composition of the atmosphere, including its proper and adventitious constituents. How and to what extent is it rendered unfit for breathing by a succession of human respirations? What other impurities, mechanical or chemical, may also contaminate it, in houses, workshops, factories, or ships?

5. Describe the "external auditory passage," its length, width, direction, and mode of closure at the bottom. Also describe the "Eustachian tube," its connections and the kind of animals it exists in—What are the uses of those two parts; and how may these be interfered with?

6. Define a reflex and a sensori-motor movement; give one example of each; state the anatomical conditions necessary for their performance, and mention any uses which they serve in the animal economy.

DOMESTIC ECONOMY.

THREE HOURS ALLOWED.

1. Enumerate under different heads what Domestic Economy embraces.

2. What circumstances would influence you in choosing a dwelling house? Show that a house at a low rent may be dearer than one at a greater charge.

3. What are the advantages and disadvantages of living in a town, especially with reference to bringing up a family?

4. Describe a simple and efficient method of ventilating a sitting-room containing an open fire-place.

5. A small bed-room, which has no fire-place, is lighted by a window, which does not open; explain fully why it would be dangerous to sleep in this room with the door shut; and say how you would establish a good system of ventilation in the apartment.

6. What are the objections to a crowded dwelling?

7. Is it an advantage to a labourer to receive his wages in small payments frequently rather than in large payments at greater intervals? Why, morally and economically?

8. Calculate the loss to a working man in the course of the year which would arise from his buying tea and sugar in small instead of large quantities, supposing the family to consist of six persons.

9. Give advice on the management of a family of six persons as regards

- (a.) Food
- (b.) Clothing
- (c.) Dwelling

the wages of the father being 30s. per week.

10. What are the various disadvantages to the family of a working man where the mother is constantly employed away from home?

1. In out-door agricultural employment.

2. In the mills of the manufacturer.

11. How do the above employments affect the future prospects, in industrial life, of children whose mothers are so employed?

12. If you wished to secure a deferred annuity for life, to commence, for instance, at the age of 60, what is the most desirable way of doing so?

13. In what does the post-office savings bank differ from the old-established savings bank?

14. Calculate the relative cost of gas and candles; the gas-burner giving as much light as three tallow candles twelve to the lb., at 6d. per lb.; the three candles burning $1\frac{1}{2}$ hour, and the gas-burner consuming 5 cubic feet of gas in the same time, the gas costing 4s. 6d. per 1,000 cubic feet.

15. How does breathing sustain animal life, and how does it warm the body? What articles of food are principally used by the inhabitants of very cold climates, and why?

16. Class the various articles of food under the heads of:—

- (a.) Flesh formers
- (b.) Heat givers
- (c.) Bone makers.

What article of food combines the three to the greatest extent?

17. In a dietary for children would you allow more or less of flesh-forming food, in proportion, than for an adult? Why?

18. Show that cheap and easily-procured food may not be a constant blessing to the nation possessing it.

19. Can you account for the alteration which takes place in the moral and physical character of a poor Irish labourer after leaving Ireland for one of the colonies?

20. Write a short essay on the value of the potato as an article of food.

POLITICAL AND SOCIAL ECONOMY.

THREE HOURS ALLOWED.

First series to be answered if possible throughout.

1. Who, during this century, have been the most distinguished writers or legislators on subjects of political economy, and with what doctrines are the names of each most connected?

2. What are the four principles of taxation laid down by Adam Smith? Which of them is said to be contrary to the imposition of a duty on malt, and how is that made out?

3. What have been the most remarkable instances of reduced taxation during the last 20 years, and what has been the result of such reduction?

4. What are the objections to the employment of convict labour under the system of assignment, more especially in the case of the skilled labourer?

5. In what way, and from what sources, is London supplied with water; and on what principle is a limit put to the amount of dividend that may be paid to shareholders in water and other similar companies?

Optional Questions.

1. Compare the incidence of taxation on poor and rich.

2. What is the principle according to which the burden of supporting the poor should be apportioned?

3. What do you understand by the principle of reciprocity as applied to commercial treaties; and how far is that principle opposed to the principle of free trade?

4. What is the relation in which profit and interest stand to each other; and in what way does Mr. J. Stuart Mill differ from what he says to be the received notion on this subject?

5. What do you understand by "average" in mercantile language; and what is the difference between general and particular average?

GEOGRAPHY.

THREE HOURS ALLOWED.

1. Taking the eastern coast line of Britain, from the Firth of Forth to the mouth of the Thames, name in successive order the principal headlands, estuaries, river mouths, and seaport towns that fall within its range.

2. Enumerate, in geographical succession, the counties that lie along the west and south-west coasts of Scotland, from Cape Wrath to the head of the Solway Firth; also the principal seaports within those limits.

3. Make a list of the principal rivers of England and Wales, classifying them as they fall respectively into the

German Ocean, the English Channel, the Bristol Channel, or the Irish Sea. Name a town situated upon each.

4. Write a brief account of any one of the countries of Continental Europe, describing its natural features, climate, productions, divisions, and chief towns.

5. Enumerate the North American colonies of Britain, stating briefly the leading characteristics of each, as to position, features, climate, and industrial resources.

6. Write a fuller account of Canada, stating the distinguishing conditions of its eastern and western divisions (Lower and Upper Canada), its industrial resources, and the position of its principal towns.

7. Enumerate the British Colonies on the Australian mainland, with the capital of each. Say which of them includes Cape York, the northernmost extremity of Australia? Which Cape Leeuwin, its S.W. point? Which Spencer's Gulf? Which Port Philip?

8. Draw (from memory) an outline map either of Canada, New South Wales, or Tasmania. Mark on it the chief natural features and the places of a few towns.

9. Give some account of Victoria (Australia): describe its coast line, chief inland features, climate, industrial resources, population (in round numbers), and chief towns.

10. Give a similar description of Queensland.

11. What is known respecting the constant, or periodical, movements of the atmosphere within the warmer latitudes of the globe. State, in general terms, their direction and limits, also the causes to which they are due.

12. What are isothermal lines? In what respect do they differ from parallels of latitude, and how can the difference be explained? Why do they rise on the western side of either continent, and sink as they are prolonged to the eastward?

ENGLISH HISTORY.

THREE HOURS ALLOWED.

N.B.—Dates are to be given in all cases.

1. What were the principal changes effected in England by the Norman Conquest?

2. What was the commencement of the House of Commons, and what have been the chief epochs in the growth of its power?

3. Describe the battle of Crecy.

4. Explain witan, socage, præmunire, impeachment, bill of pains and penalties.

5. What were the claims of Henry VII. to the throne of England?

6. What was the Covenant, and what were its effects?

7. Mention the chief events and measures of the reign of William III.

8. Give a short account of the American War of Independence.

SPECIAL SUBJECT.

9. What were the effects of John's surrender of his crown to the Pope?

10. Give the provisions of Magna Charta.

11. Describe the battle of Lewes.

12. Write the life of Simon de Montfort.

ENGLISH LITERATURE.

THREE HOURS ALLOWED FOR THE TWO AUTHORS SELECTED BY THE CANDIDATE.

SHAKESPEARE.

(MACBETH.—HENRY V.—THE TEMPEST.)

I.

1. State the connexion in which each of the following passages occurs, explain every allusion, and notice the unusual words and grammatical constructions:—

- (a) The sin upon my head, dread Sovereign !
For in the book of Numbers is it writ—
When the man dies, let the inheritance
Descend unto the daughter.
- (b) The sin of my ingratitude even now
Was heavy on me : thou art so far before,
That swiftest wing of recompense is slow
To overtake thee. 'Would thou hadst less deserv'd;
That the proportion both of thanks and payment
Might have been mine ! only I have left to say,
More is thy due than more than all can pay.
- (c) The slave, a member of the country's peace,
Enjoys it ; but in gross brain little wots
What watch the king keeps to maintain the peace,
Whose hours the peasant best advantages.
- (d) ————Sitting on a bank,
Weeping again the king my father's wrack,
This music crept by me upon the waters.
- (e) ————More will I do,
Though all that I can do is nothing worth,
Since that my penitence comes after all,
Imploring pardon.
- (f) You are three men of sin, whom destiny
(That hath to instrument this lower world,
And what is in it) the never-surfeited sea,
Hath caused to belch up you, and on this island
Where man doth not inhabit.
- (g) ————Now does he feel
His secret murders sticking on his hands ;
Now minutely revolts upbraid his faith-breach ;
Those he commands move only in command,
Nothing in love ; now does he feel his title
Hang loose about him, like a giant's robe
Upon a dwarfish thief.

2. Turn the passages *a* and *b* into plain prose.

3. Explain the expressions—"the shales and husks of men"—"the Mediterranean flote"—"the law Salique"—"kernes and gallow-glasses"—"the still-vexed Bermoothes."

4. Give some account of the Chorus in Henry V.

II.

1. Briefly sketch the plot of the first act of Henry V., or of the third act of Macbeth.

2. From what historical sources did Shakspeare take the plots of Henry V. and Macbeth ? In what particulars has he deviated from historical authority ?

3. What do you know of the sources of the text of these three plays ?

4. Give some account of Shakspeare's life while he resided in London.

REED.

INTRODUCTION TO ENGLISH LITERATURE.

1. Which are the peculiar advantages of the English language compared with most other languages ? Why are native Saxon words to be generally preferred to words of foreign origin ?

2. Give some account of the process by which the English language has been formed.

3. Explain the distinction between *shall* and *will*.

4. "If Chaucer was unfortunate in the period of his country's language, he was happy in the era of his country's history." Explain this statement. Sketch the plan of the *Canterbury Tales*.

5. What place in the history of English prose literature does Mr. Reed assign to Richard Hooker ? What do you know of Hooker's great work ?

6. Give some account of Comus, or of Lycidas.

7. Express briefly the substance of Mr. Reed's remarks on Sunday reading. What are his objections to the *Paradise Lost* ? Do you agree with them ?

8. Name the great essayists of the time of Queen Anne, with their principal works. Give some account of the *Spectator*.

9. What was the effect of the French Revolution, and of the causes which led to it, upon literature, and upon English literature in particular ?

10. What is the predominating tendency of the poetry of Wordsworth ? What do you know of "The Excursion ?"

11. What English authors have shown the faculties of Wit and Humour to the greatest advantage ? What are the chief abuses to which those faculties are liable ?

12. What are the characteristics of a true letter ? Who are the best writers of letters in our language ? What are the chief faults in Pope's letters ?

BUTLER.

THE ANALOGY.

I.

1. How is probable evidence distinguished from demonstrative evidence ? How does Butler illustrate the distinction ?

2. "Nor can we find anything throughout the whole-analogy of nature to afford us even the slightest presumption that animals ever lose their living powers." Briefly sketch the train of reasoning into which these words are introduced.

3. What are *final causes* ? In what way may the existence of an intelligent Governor of the world be proved from them ?

4. How does Butler refute the notion that "things may be now going on throughout the universe, and may go on hereafter, in the same mixed way as here at present upon earth—virtue sometimes prosperous, sometimes depressed ; vice sometimes punished, sometimes successful ?"

5. Explain the distinction between *passive habits* and *active habits*. In what way does this subject bear upon the line of argument ?

6. In what sense does Butler say we are to understand "that general assertion, that the opinion of necessity is essentially distinctive of all religion ?"

7. By what arguments is the objection to Christianity met, that it has done but little to improve the world ?

8. State the distinction between moral precepts and positive precepts, and give examples.

9. Which are the main arguments on which Butler founds the credibility of a revealed religion ?

II.

1. Sum up, as briefly as you can, the author's purpose in the first part of the Analogy.

2. Which are the main objections that have been urged against arguing from the analogy of Nature to Religion ? In what way may they be answered ?

3. Give some account of Bishop Butler. Name his other works besides the Analogy.

MILTON.

PARADISE LOST.—BOOK I.—VI.

I.

1. In what connexion does each of the following passages occur ? Explain every allusion, and notice any unusual words or grammatical constructions which occur in them :—

- (a) ————Not that fair field
Of Enna, where Proserpine gathering flowers,
Herself a fairer flower, by gloomy Dis
Was gathered, which cost Ceres all that pain
To seek her through the world.

- (b) ———As when by night the glass
Of Galileo, less assured, observes
Imagined lands and regions in the moon;
Or pilot, from amidst the Cyclades,
Delos or Samos first appearing, kens
A cloudy spot.
- (c) This inaccessible high strength, the seat
Of Deity supreme, us dispossessed,
He trusted to have seized.
- (d) O, for that warning voice, which he who saw
The Apocalypse heard cry in heaven aloud;
Then when the dragon, put to second rout,
Came furious down to be revenged on men,
"Woe to the inhabitants on earth!"
- (e) High on a throne of royal state, which far
Outshone the wealth of Ormus and of Ind,
Or where the gorgeous East with richest hand
Showers on her kings barbaric pearl and gold,
Satan exalted sat——
- (f) ———Anon they move,
In perfect phalanx, to the Dorian mood
Of flutes and soft recorders.
2. Give a short account of Satan's passage from hell to the earth.
 3. Servant of God, well done; well hast thou fought
The better fight, who single hast maintain'd
Against revolted multitudes the cause
Of truth: in word mightier than they in arms;
And for the testimony of truth hast borne
Universal reproach, far worse to bear
Than violence; for this was all thy care,
To stand approved in sight of God, though worlds
Judged thee perverse: the easier conquest now
Remains thee, aided by this host of friends,
Back on thy foes more glorious to return,
Than scorn'd thou didst depart.
 - (a) Give the sense of this passage in plain prose, adding as little as possible to the number of words.
 - (b) To whom is it addressed, and on what occasion?
 - (c) Notice any unusual expressions contained in it.
 4. Briefly sketch the substance of Satan's address to the sun, or of Milton's address to light.

II.

1. What personal allusions to the poet himself, or his contemporaries, occur in the *Paradise Lost*?
2. Give some account of Milton's life, and especially of the circumstances under which the *Paradise Lost* was written.
3. What do you know of Milton's prose works?

LOGIC AND MENTAL SCIENCE.

THREE HOURS ALLOWED.

LOGIC.

1. State in detail what is treated of under the heads simple apprehension, judgment, and reasoning respectively.
2. What are the predicables, and what the predicaments? Give illustrations of both.
3. What is meant by the comprehension and what by the extension of a term? How are the two related to each other? Give examples.
4. Give the rules of definition and division. When is a division false?
5. In how many ways may propositions be converted? Give the rules of conversion for each class of propositions designated by the letters A, E, I, O, respectively.
6. Explain what is meant by the major, minor, and middle terms of a syllogism, with illustrations.
7. Evolve the following sentences into syllogisms, pointing out in each case the major, minor, and conclu-

sion:—(a). Many of the heathen philosophers recommended persecution, and therefore could not have been good men. (b). Because they are envious and ill-natured the censorious are generally detested. (c). Most of the learned in the fifteenth century believed in witchcraft, and must consequently have been very credulous persons.

8. How many figures are there? Give the special rules of each. In what mood and figure are the following syllogisms drawn? How are they symbolically designated?

All true penitents will find mercy.

Some true penitents have been great sinners.

Some who have been great sinners will find mercy.

Many philosophers have contradicted their principles by their practice.

All who do so are dishonest.

Some dishonest persons have been philosophers.

9. What is an enthymeme, an epicheirema, and a sorites? Give an example of each.

PALEY'S MORAL PHILOSOPHY.

1. State any arguments you can advance for or against a moral sense in man.
2. What is meant by utilitarianism? In what sense is Paley a utilitarian, and how does he differ from others?
3. In what, according to Paley, may we say that human happiness does and does not consist?
4. What is the object, the rule, and the motive of virtue respectively as stated by Paley?
5. Give Paley's definition and division of rights.
6. Give some account of the rise of property. Show its use, and on what specific right it is founded.

MILL'S LOGIC OF INDUCTION.

1. Distinguish between induction strictly so called, and induction improperly so called.
2. Give Mill's view of the law of causation. Is his theory of causation universally held? What other theories have been propounded?
3. Explain the four methods of experimental inquiry according to Mills' analysis, and give the canon of each.
4. What is an hypothesis? What is its use in philosophical inquiry? What errors must be guarded against in its use?
5. Explain Mills' view of the nature and uses of analogy in philosophical researches.

STEWART'S PHILOSOPHY OF THE HUMAN MIND.

1. State any of the advantages arising from the study of the human mind, and the method by which it should be conducted.
2. Give a brief sketch of Reid's controversy on perception, and the conclusions to which he arrived.
3. Give a philosophical definition of abstraction, and then sketch the views of the nominalists and realists respectively.
4. What is meant by the association of ideas? Give a classification of the laws of association.
5. State what Stewart says on the different kinds of memory, and the means by which memory may be cultivated.
6. Distinguish between conception and imagination. Give illustrations of both.

BUTLER'S SERMONS.

1. What does Butler mean by human nature, and what elements does he affirm it to consist?
2. Give his reasons for asserting the supremacy of conscience as a principle of human action.
3. In what sense may a person who follows his appetites *only*, be said to act contrary to nature?
4. Give a concise abstract of Butler's whole argument, to show that human nature, rightly interpreted, leads invariably to the practice of virtue.

LATIN AND ROMAN HISTORY.

THREE HOURS ALLOWED.

SECTION I.

Translate:—

At regina, nova pugnae conterrita sorte,
 Flebat et ardentem generum moritura tenebat:
 "Turne, per has ego te lacrimas, per si quis Amatae
 Tangit honos animum—spes tu nunc una, senectae
 Tu requies miserae, decus imperiumque Latini
 Te penes, in te omnis domus inclinata recumbit—
 Unum oro: desiste manum committere Teucris.
 Qui te cumque manent isto certamine casus,
 Et me, Turne, manent: simul haec invisa relinquam
 Lumina, nec generum Aenean captiva video."
 Accepit vocem lacrimis Lavinia matris
 Flagrantes perfusa genas, cui plurimus ignem
 Subiecit rubor, et calefacta per ora cucurrit.
 Indum sanguineo veluti violaverit ostro
 Si quis ebur, aut mixta rubent ubi lilia multa
 Alba rosa: tales virgo dabat ore colores.

1. Parse fully, giving both syntax and accident, the words *sorte, lumina, lacrimis, genas, cui, violaverit*.

2. Give the present and perfect tenses indicative active and the supines of the verbs *tangit, committere, manent, relinquam, video, dabat*.

SECTION II.

Translate:—

Ac velut immissi diversis partibus ignes
 Ardentem in silvam et virgulta sonantia lauro,
 Aut ubi decursu rapido de montibus altis
 Dant sonitum spumosi amnes et in aquora currunt,
 Quisque suum populatus iter: non segnius ambo
 Aeneas Turnusque ruunt per proelia: nunc, nunc
 Fluctuat ira intus, rumpuntur nescia vinci
 Pectora; nunc totis in vulnera viribus itur.
 Murranum hic, atavos et avorum antiqua sonantem
 Nomina, per regesque actum genus omne Latinos,
 Praecipitem scopulo atque ingentis turbine saxi
 Executit effunditque solo: hunc lora et juga subter
 Provolvare rotas; crebro super ungula pulsu
 Incita nec domini memorum proculcat equorum.

1. Parse fully, giving both syntax and accident, the words—*partibus, lauro, sonitum, quisque, vinci, turbine, provolvere, domini*.

2. Give the present and perfect tenses indicative active and the supines of the verbs *currunt, rumpuntur, executit, effundit*.

3. Explain the construction of "*itur*," and mention any other verbs that are used in the same way.

SECTION III.

Translate:—

"Saepe audiavi a majoribus natu, qui se porro pueros a senibus audisse dicebant, mirari solitum C. Fabricium, quod, quum apud regem Pyrrhum legatus esset, audisset a Thessalo Cineas esse quemdam Athenis, qui se sapientem profiteretur, eumque dicere omnia, quae faceremus, ad voluptatem esse referenda. Quod ex eo audientes M. Curium et Ti. Coruncanum optare solitos ut id Samnitibus ipsique Pyrrho persuaderetur, quo facilius vinci posset, quum se voluptatibus dedissent. Vixerat M. Curius cum P. Decio, qui quinquennio ante eum consulum se pro re publica quarto consulatu devoverat: norat eundem Fabricium, norat Coruncanum: qui quum ex sua vita tum ex ejus, quem dico, Decii facto judicabant esse profecto aliquid natura pulcrum atque praeclarum quod sua sponte peteretur quodque sprete et contempta voluptate optimus quisque sequeretur."

1. Parse fully, giving both syntax and accident, the words—*pueros, Athenis, omnia, Samnitibus, natura, voluptate*.

2. Give the present and perfect tenses indicative ac-

tive and the supines of the verbs *dicebant, faceremus, persuaderetur, vixerat*.

3. Explain why *audisset, profiteretur, persuaderetur, peteretur*, are in the subjunctive mood.

SECTION IV.

Translate:—

"Haec igitur lex in amicitia sancitur, ut neque rogemus res turpes nec faciamus rogati. Turpis enim excusatio est et minime accipienda quum in caeteris peccatis tum si quis contra rem publicam se amici causa fecisse fateatur. Etenim eo loco, Fanni et Scaevola, locati sumus, ut nos longe prospicere oporteat futuros casus rei publicae. Deflexit jam aliquantulum de spatio curriculoque consuetudo majorum. Ti. Gracchus regnum occupare conatus est vel regnavit is quidem paucos menses. Num quid simile populus Romanus audierat aut viderat? Hunc etiam post mortem secuti amici et propinqui quid in P. Scipione effecerint sine lacrimis non queo dicere. Nam Carbonem quocumque modo potuimus propter recentem poenam Ti. Gracchi sustinuisse. De C. Gracchi autem tribunatu quid expectem non libet augurari: serpit deinde res, quae proclivius ad perniciem, quum semel coepit, labitur."

1. Parse fully, giving both syntax and accident, the words—*sancitur, casus, majorum, menses, Carbonem, perniciem*.

2. Give the present and perfect tenses indicative active and the supines of the verbs *prospicere, effecerint, queo, sustinuisse*.

3. Explain why *rogemus, fateatur, oporteat, effecerint*, are in the subjunctive mood.

SECTION V.

1. What was the duty of the Censor? Mention any noted Censors. When was the office instituted, and when opened to the plebeians?

2. Give an account of Spurius Cassius, and of the Agrarian Law which made him famous.

3. What were the laws of the twelve tables? What was their general character?

4. Write a short history of Camillus.

5. What was the original Roman law of debt? How was it modified? and under what circumstances.

6. Give an account of the first Samnite war.

SECTION VI.

1. How was the Roman senate filled in ordinary times? Mention any special cases.

2. Give an account of Tiberius Gracchus.

3. What effect had slavery on Roman politics?

4. Give an account of the fall of Carthage.

5. Write a short history of Sulla.

6. In the time of Julius Caesar was the aristocratic or the democratic party the champion of liberty? And why?

FRENCH.

THREE HOURS ALLOWED.

PART I.

Candidates for a Third-class Certificate are requested to translate into English the following extract, and to answer the grammatical questions thereto annexed, in the order in which they are placed. This first Part is all that will be expected of them.

Translate into English:—

L'Ermitte Pierre traversa l'Italie, passa les Alpes, parcourut la France et la plus grande partie de l'Europe, embrasant tous les cœurs du zèle dont il était dévoré. Il voyageait monté sur une mule, un crucifix à la main, les pieds nus, la tête découverte, le corps ceint d'une grosse corde, couvert d'un long froc et d'un manteau de l'étoffe la plus grossière. La singularité de ses vêtements était un spectacle pour le peuple; l'austérité de ses mœurs, sa

charité, la morale qu'il prêchait, le faisaient révéler comme un saint.

Il allait de ville en ville, de province en province, implorant le courage des uns, la piété des autres; tantôt il se montrait dans la chaire des églises, tantôt il prêchait dans les chemins et sur les places publiques. Son éloquence était vive et emportée, remplie d'apostrophes véhémentes qui entraînaient la multitude. Il rappelait la profanation des saints lieux et le sang des Chrétiens versé par torrents dans les rues de Jérusalem; il invoquait tour à tour le ciel, les saints, les anges, qu'il prenait à témoin de la vérité de ses récits; il s'adressait à la montagne de Sion, à la roche du Calvaire, au mont des Oliviers, qu'il faisait retentir de sanglots et de gémissements. Quand il ne trouvait plus de paroles pour peindre les malheurs des fidèles, il montrait aux assistants le crucifix qu'il portait avec lui; tantôt il se frappait la poitrine et se meurtrissait le sein, tantôt il versait un torrent de larmes.

Le peuple se pressait en foule sur les traces de Pierre. Le prédicateur de la guerre sainte était partout reçu comme un envoyé de Dieu; on s'estimait heureux de toucher ses vêtements; le poil arraché à la mule qu'il montait était conservé comme une sainte relique. A sa voix les différends s'apaisaient dans les familles, les pauvres étaient secourus, la débauche rougissait de ses excès; on ne parlait que des vertus de l'éloquent cénobite; on racontait ses austérités et ses miracles; on répétait ses discours à ceux qui ne les avaient point entendus et qui n'avaient pu s'édifier par sa présence.

MICHAUD, "*Histoire des Croisades*."

1. Parse the first two sentences of the above extract.
2. Write the five primitive tenses of all the verbs contained above, each verb to be given in a separate line.
3. Put the article and a suitable epithet before each of the following nouns, so as to show its gender:—*Exercice, zèle, arbre, feuillage, dent, rage, peur, tonnerre, nef, crépuscule*.
4. Give the adjective that corresponds to each of these substantives which occur in the extract:—*Cœur, main, corps, singularité, austérité, mœurs, ville, province, courage, piété, église, lieu, sang, ciel, ange, guerre, poil, voix, excès, vertu, miracle*.
5. What remark does the spelling of *voyageait* suggest (4th line of the extract)?
6. What peculiarities of orthography are there in the conjugation of such verbs as *avancer, essayer, révéler, appeler, rejeter*?
7. *Les pieds nus* (4th and 5th lines). There is another way of expressing *bare-footed* in French. State how this other construction affects the article and the spelling of *nu*. To what other adjective does the same rule apply?
8. Explain the spelling of the past participle *entendus* in the last line but one.
9. *Le poil arraché à la mule*, &c. The preposition *à* will here be rendered by "from." Can you name other verbs after which the preposition *à* is thus used, instead of *de*?
10. *Les différends s'apaisaient dans les familles* (sixth line from the end). Show by several similar examples how much more frequently the reflexive voice is used in French than in English.
11. Write, with all their variations of form, according to gender and number, the words which correspond in French to *my, thy, his, her, its, our, your, their; mine, thine, his, hers, its, ours, yours, theirs*.
12. Give, with suitable examples, *any three* important rules on the syntax of the verb in French, comparing or contrasting that language with your own as much as possible.
13. Write the French names of:—1. The most common animals, domestic and others; 2. Flowers and vegetables; 3. Trees and fruits; 4. The principal pieces of furniture of a house; 5. The most common metals and minerals.
14. Conjugate the preterit, the imperative, and present subjunctive of the verbs *devenir, se repentir, se prévaloir*, and *mettre*.

PART II.

Candidates for a Second-class Certificate are to answer the questions Nos. 9, 10, 11, and 12 in Part I., together with those in Part II., and to translate the English extract and idiomatic expressions which follow.

1. What is the exact purpose of the pronoun *vous* in the following quotation?

Maint estafier accourt; on *vous* happe notre homme,
On *vous* l'échine, on *vous* l'assomme.

LA FONTAINE.

2. Explain and correct the mistake in the following construction of the pronoun:—Il n'entendra pas raison, il n'a jamais voulu l'entendre.

Si vous voulez qu'on vous rende justice, rendez-*la* aux autres.

3. Give, with examples, all the rules for the use of the subjunctive mood in French.

4. What is the difference of meaning implied by the difference of spelling in these two expressions?

Le peu de bonté qu'il m'a *montré*.....

Le peu de bonté qu'il m'a *montrée*.....

Complete the sentence in each case.

Translation:—

As Sir Roger is landlord to the whole congregation, he keeps them in very good order, and will suffer nobody to sleep in it besides himself; for if by chance he has been surprised into a short nap at sermon, upon recovering out of it he stands up and looks about him, and if he sees anybody else nodding, either wakes them himself, or sends his servants to them. Several other of the old knight's particularities break out upon these occasions. Sometimes he will be lengthening out a verse in the singing Psalms half a minute after the rest of the congregation have done with it; sometimes, when he is pleased with the matter of his devotion, he pronounces "Amen" three or four times to the same prayer; and sometimes stands up, when everybody else is upon his knees, to count the congregation, or see if any of his tenants are missing. This authority of the knight, though exerted in that odd manner which accompanies him in all circumstances of life, has a very good effect upon the parish, who are not polite enough to see anything ridiculous in his behaviour; besides that, the general good sense and worthiness of his character make his friends observe these little singularities as foils, that rather set off than blemish his good qualities. As soon as the sermon is finished, nobody presumes to stir till Sir Roger is gone out of the church. The knight walks down from his seat in the chancel between a double row of his tenants, that stand bowing to him on each side, and every now and then inquires how such a one's wife, or mother, or son, or father do, whom he does not see at church; which is understood as a secret reprimand to the person that is absent.

ADDISON.

Idioms:—

1. Tenez-le vous pour dit.
2. Il ne sait où donner de la tête.
3. Il nage entre deux eaux.
4. Je n'ai pas mes coudées franches.
5. Ils travaillent à qui mieux mieux.
6. On lui a coupé l'herbe sous le pied.
7. Poussez-leur l'épée dans les reins.
8. Vous n'y allez pas de main-morte.
9. J'en ai de reste.
10. Nous sommes logés à la même enseigne.
11. Prenez la balle au bond.
12. Je suis des vôtres.

PART III.

Candidates for a First-class Certificate are expected to translate the above idioms and the extract (down to "are missing" only), and to answer, in French, the grammatical questions Nos. 1, 2, and 4 (Part II.), as also the following:—

Literature.—1. State what you know of either Rollin or Bayle.

2. Give a short account of any one work of Fénelon, Massillon, or Louis Racine.

History.—Write a *résumé* of the last fifteen years of the reign of Louis XIV.; or, if you prefer it, dwell at some length upon any one important event of that period.

GERMAN.

THREE HOURS ALLOWED.

Each candidate is expected to translate one of the passages of Section I., to answer some of the questions, and to turn into German several of the sentences and pieces given in Section III. Candidates for a first class, must translate one piece of Section I., answer (e), (f) and (g) of Section II., and render into German 16—20 inclusive, of Section III., and write the essay:—

SECTION I.

1. Dieser Tag war es, um dessentwillen Gustav das baltische Meer durchschiffte, auf entlegener Erde der Gefahr nachjagte, Krone und Leben dem untreuen Glück anvertraute. Die zwei grössten Heerführer ihrer Zeit, beide bisher unüberwunden, sollen jetzt in einem lange vermiedenen Kampfe mit einander ihre letzte Probe bestehen; einer von beiden muss seinen Ruhm auf dem Schlachtfelde zurücklassen. Beide Hälften von Deutschland haben mit Furcht und Zittern diesen Tag herannahen sehen; bang erwartet die ganze Mitwelt den Ausschlag desselben, und die späte Nachwelt wird ihn segnen oder beweinen.

Die Entschlossenheit, welche den Grafen Tilly sonst nie verliess, fehlte ihm an diesem Tage. Kein fester Vorsatz, mit dem Könige zu schlagen, ebenso wenig Standhaftigkeit, es zu vermeiden. Wider seinen Willen riss ihn Pappenheim dahin. Nie gefühlte Zweifel kämpften in seiner Brust, schwarze Ahnungen umwölkten seine immer freie Stirn. Der Geist von Magdeburg schien über ihm zu schweben.

2. Ist Frieden stiften, Hass
Versöhnen ein Geschäft der Hölle? Kommt
Die Eintracht aus dem ew'gen Pfuhl hervor?
Was ist unschuldig, heilig, menschlich gut,
Wenn es der Kampf nicht ist ums Vaterland?
Seit wann ist die Natur so mit sich selbst
Im Streite, dass der Himmel die gerechte Sache
Verlässt, und dass die Teufel sie beschützen?
Ist aber das, was ich dir sage, gut,
Wo anders als von oben konnt' ich's schöpfen?
Wer hätte sich auf meiner Schäfertrift
Zu mir gesellt, das kind'sche Hirtenmädchen
In königlichen Dingen einzuweihn?
Ich bin vor hohen Fürsten nie gestanden,
Die Kunst der Rede ist dem Munde fremd.
Doch jetzt, da ich's bedarf, dich zu bewegen,
Besitz' ich Einsicht, hoher Dinge Kunde,
Der Länder und der Könige Geschick
Liegt sonnenhell vor meinem Kindesblick,
Und einen Donnerkeil führ' ich im Munde.

3. Alter Freund! immer getreuer Schlaf, fiehst du mich auch wie die übrigen Freunde? Wie willig senkstest du dich auf mein freies Haupt herunter, und kühltest, wie ein schöner Myrthenkranz der Liebe, meine Schläfe! Mitten unter Waffen, auf der Woge des Lebens, ruht' ich leicht athmend, wie ein aufquellender Knabe, in deinen Armen. Wenn Stürme durch Zweige und Blätter sausten, Ast und Wipfel sich knirschend bewegten, blieb innerst doch der Kern des Herzens ungeregt. Was schüttelt dich nun? Was erschüttert den festen treuen Sinn? Ich fühl's, es ist der Klang der Mordaxt, die an meiner Wurzel nascht. Noch steh' ich aufrecht und ein innerer Schauer durchfährt mich. Ja, sie überwindet, die verrätherische Gewalt; sie untergräbt den festen hohen Stamm, und eh' die Rinde dorrt, stürzt krachend und

zerschmetternd deine Krone. Warum denn jetzt, der du so oft gewalt'ge Sorgen gleich Seifenblasen dir vom Haupte weggewiesen, warum vermagst du nicht die Ahnung zu verschrecken, die tausendfach in dir sich auf und nieder treibt? Seit wann begegnet der Tod dir fürchterlich? mit dessen wechselnden Bildern, wie mit den übrigen Gestalten der gewohnten Erde, du gelassen lebstest.

4. Ottokar von Böhmen, ein viel mächtigerer Fürst als der Graf von Habsburg, glaubte keineswegs dem neuen Kaiser gehorchen zu müssen. Dazu kam, dass die österreichischen Stände bittere Klagen gegen König Ottokar erhoben, wie er sie bedrücke und viele Ungerechtigkeit übe. Also liess Rudolph zuerst den König einladen, dass er auf dem Reichstage zu Nürnberg im Jahre 1274 erscheine und von Rechtswegen den Lehnid leisten solle. Aber der König kam weder diesesmal, noch auf einem zweiten Tage zu Würzburg; und auf einen dritten zu Augsburg, im Jahre 1275, schickte er nur den Bischof Wernhard von Seckau als seinen Gesandten, und dieser war so dreist, vor den versammelten Fürsten eine lateinische Rede anzuheben, worin er beweisen wollte, dass Kaiser Rudolph's Wahl ungültig sei. Rudolph unterbrach ihn, und sprach: "Herr Bischof, wenn ihr etwas mit meinen Geistlichen abzumachen habt, so redet aller Dinge lateinisch, wenn's aber mich oder die Reichsrechte angeht, so redet deutsch, wie es der Brauch ist." Und die Fürsten, da sie inne wurden, der Bischof wolle Rudolph's Kaiserwahl antasten, enthielten sich kaum, dass sie ihn nicht zur Thüre hinaustrieben; aber der König verhinderte es und liess den Bischof am nächsten Tage von Augsburg abreisen.

SECTION II.—GRAMMAR AND IDIOMS.

- (a.) Decline *derselbe, dieselbe, dasselbe, and wer.*
(b.) When does the superlative end in *sten* and has *am* before it? Give three examples.
(c.) Decline *das harte Schicksal*—*schwerer Stein, unser bestes Pferd.*
(d.) Put the definite article before the following substantives, and add the genitive singular and the nominative plural:—*Berg, Kenntniss, Braut, Thaler, Blatt, Loch, Maus, Hand.*
(e.) In what do separable compound verbs differ from the inseparable. Illustrate their differences by three examples.
(f.) State the second person singular, present and imperfect, both in the indicative and subjunctive of:—*Befehlen, bieten, ablassen, verstehen, nachgeben, vermögen, bedürfen.* Add also the participle past of each of these verbs.
(g.) Es ist gar nicht mit ihm auszukommen.
Das wird noch übel ablaufen.
Ich mache mir gar nichts daraus.
Es geht im Hause um.
Er hat sich umgebracht.
Reden Sie doch nicht so ins Blaue hinein.
Der hat das Pulver auch nicht erfunden.
Wer sich nur darauf verstünde!
Setzen Sie mir das einmal auseinander.
Damit hat er mir einen Streich durch die Rechnung gemacht.
Er wird nimmermehr auf einen grünen Zweig kommen.

SECTION III.

Translate into German ten of the following passages. The writing, either in English, or German characters, must be very legible.

1. That is all the same to me.
2. I am going to buy three sorts of wine.
3. He arrived in town at half-past three in the morning.
4. They have been in this country these sixteen years.
5. They who are cruel cannot be good.
6. We who have long experience know more about it.
7. I should like to know what has become of them.
8. My brother is only eight years and a half old.

9. They have been obliged to leave town.
10. He had a new carriage made for him.
11. The judge ordered him to be whipped.
12. I have often been asked about the cause of it.
13. He ought to have been ashamed of himself.
14. The older he grows, the weaker he becomes.
15. We have heard her sing but once.
16. We received their answer but yesterday.
17. I insist upon your doing it directly.
18. Having left his house but ten minutes ago, he cannot have reached his office.
19. She is said to be a very clever writer.
20. It seems clear, that the wages of labour, estimated in money, were in 1685 not more than half of what they are now; and there were few articles important to the working man, of which the price was not in 1685 more than half of what it is now. Beer was undoubtedly much cheaper in that age than at present. Meat was also cheaper, but was still so dear that hundreds of thousands of families scarcely knew the taste of it. In the cost of wheat, there has been very little change. The average price of the quarter, during the last twelve years of Charles the Second, was fifty shillings. Bread, therefore, such as is now given to the inmates of a workhouse, was then seldom seen, even on the trencher of a yeoman or of a shopkeeper. The great majority of the nation lived almost entirely on rye, barley and oats.

Write in German a short essay on "The causes of strikes."

ITALIAN.

THREE HOURS ALLOWED.

Candidates for a First-class Certificate are required to translate into English prose the following extracts, and answer the grammatical questions attached to them:—

I.

Non come fiamma che per forza è spenta,
Ma che per se medesima si consume,
Se n' andò in pace l'anima contenta.
A guisa d'un soave e chiaro lume,
Cui nutrimento a poco a poco manca,
Tenendo al fin il suo usato costume.
Pallida no; ma più che neve bianca,
Che senza vento in un bel colle fiocchi,
Parea posar, come persona stanca.
Quasi un dolce dormir ne' suoi begli occhi,
Sendo lo spirito già da lei diviso,
Era quel che morir chiaman gli sciocchi.
Morte bella pareva nel suo bel viso.

(F. PETRARCA, Trionfo della Morte.)

1. *Spenta*: Give the infinitive and the first person preterite of this participle.
2. *Consume*: This is a poetical licence for the sake of the rhyme. How should this word end according to grammar?
3. *Se n' andò*: What is the difference between this expression and simply *andò*?
4. *Parea*: Write the whole of present and the preterite tense, indicative mood, of this verb.
5. *Sendo*: What is the more common form of this word?

II.

Sveno, del re de' Dani unico figlio,
Gloria e sostegno alla cadente etade,
Esser tra quei bramò che, il tuo consiglio
Seguendo, han cinto per Gesù le spade:
Nè timor di fatica, o di periglio,
Nè vaghezza del regno, nè pietade
Del vecchio genitor, sì degno affetto
Intepidir nel generoso petto.

Lo spingeva un desio d'apprender l'arte
Della milizia faticosa e dura
Da te sì nobil mastro; e sentia in parto
Sdegno e vergogna di sua fama oscura,
Già di Rinaldo il nome in ogni parte
Con gloria udendo in verdi anni matura:
Ma più ch' altra cagione, il mosse il zelo
Non del terren, ma dell' onor del cielo.

(T. Tasso, La Gerusalemme.)

1. *Cinto*: Give the whole present and preterite tense, indicative mood, of this participle.
2. *Intepidir*: What part of the verb does this word stand for in this instance? How should it otherwise be written?
3. *Mosse*: Write the whole present tense, indicative mood, of this verb.

III.

Translate into Italian:—

After expressing his regret that I had not been able to prolong my stay at Venice, my noble friend said, "At least, I think, you might spare a day or two to go with me to Arqua. I should like," he continued thoughtfully, "to visit that tomb with you;" then, breaking into his usual gay tone, "a pair of poetical pilgrims—eh, what say you?" That I should have declined this offer, and thus lost the opportunity of an excursion which would have been remembered as a bright dream through all my after-life, is a circumstance I never can think of without wonder and self-reproach. But the main design on which I had then set my mind of reaching Rome, and, if possible, Naples, within the limited period which circumstances allowed, rendered me far less alive than I ought to have been to the preciousness of the episode thus offered to me.

(T. MOORE'S Life of Lord Byron.)

IV.

IDIOMATIC PHRASES.

(To be translated into English, not literally, but by equivalent expressions.)

Stetti in forse.
Se mi venisse il destro.
Non so trovare il verso.
Egli sparlà d'ognuno.
Colgo quest' occasione.
Si fece avanti.
Parlatemi chiaro.
Cogliere il punto.
Che ve ne pare?
Se l'ebbe a male.

Candidates for a Second or Third-class Certificate are required to translate the following extract into English, and likewise to answer the grammatical questions given below:—

Proponendomi io di scrivere la storia delle cose succedute in Italia ai tempi nostri, non so quello, che gli uomini della presente età saran per dire di me. Conciossiachè mancati col finire del decimosesto secolo gli eccellenti Storici fiorentini, i quali soli forse fra gli Storici di tutti i tempi, e di tutte le nazioni scrissero senza studio di parti la verità, i tempi andarono sì fattamente peggiorandosi, e l'adulazione in guisa tale distendendosi, che il volere scrivere la storia con sincerità pare opera piuttosto incredibile, che maravigliosa. E non so perch' io m'oda dire tuttavia, che la storia è il lume del tempo, e che insegna bene il fatto loro ai popoli, ed ai principi: imperciocchè scritta secondo il costume, che prevalse, io non so quale altra cosa ella possa insegnare altrui, fuori che a dir le bugie; e qual buona guida nel malagevole cammino della nostra vita siano queste, ognun sel vede, stantechè i negozj umani con la realtà si governano: non con le chimere. E già i più tra coloro, ai quali io appalesai

questo mio pensiero, mi dissero apertamente, o ch' io non oserei, o ch' io non potrei, od all' ultimo ch' io non dovrei mandarlo ad esecuzione. Pure, pare a me, che se l'adulazione si cerca da una parte, che certamente si cerca, molto ancora più si offra dall'altra, e che più ancora siano da accagionarsi di viltà gli scrittori, che di rigore, o di ambizione i principi.

(C. BOTTA, Storia d'Italia.)

GRAMMATICAL QUESTIONS.

1. Decline, with the definite articles in both numbers, the nouns *pianeta, re, azione, moglie, stuolo, colpa*.

2. Give two or three examples of an Italian noun substantive, with its augmentative and diminutive terminations.

3. Write the possessive, demonstrative, and relative pronouns in both genders and numbers, showing which of those pronouns take the definite article and which do not. Explain *when* the article should be omitted before such pronouns as otherwise require it.

4. Write the persons given of the following verbs of the regular conjugations:—They believe (*credere*); we were working (*lavorare*); you went away (*partire*); thou shalt feel (*sentire*); I would hope (*sperare*); let him lose (*perdere*); speak thou (*favellare*); fly not thou (*fuggire*); freed (*liberare*); following (*seguire*).

SPANISH.

THREE HOURS ALLOWED.

PART I.

Candidates for the First-class Certificate will have to translate the following passage into Spanish, to render into English or French the idiomatic phrases, and to write a short essay:—

Lope de Vega is called a prodigy of nature, and such he really may be reckoned, not that we can ascribe to him a sublime genius, or a mind abounding with fine original thought; but his fertility of invention and readiness of versifying are beyond competition. He required no more than four-and-twenty hours to write a versified drama of three acts, interspersed with sonnets, and abounding in intrigue. This astonishing facility enabled him to supply the Spanish theatre with more than two thousand original dramas. In general the theatrical manager carried away what he wrote before he had even time to revise it; and immediately a fresh applicant would arrive to prevail on him to commence a new piece. According to his own opinion he wrote on an average five sheets a-day, so that he must have written upwards of 21,300,000 verses.

This peculiar gift of rapid composition will appear more extraordinary when we attend to the nature of Lope's versification. At every step we meet with acrostics, echoes, and compositions of that perverted and laborious kind, which, though they require no genius, exact much time that one should think such a voluminous poet could little afford to waste.—*Hallam's History of Europe*.

CHISTES.

Translate into English—El rey Don Alonso de Aragon decia que cinco cosas le agradaban mucho; lina seca para quemar; caballo viejo para cabalgar, vino anejo para beber, amigos ancianos para conversar, y libros antiguos para leer.

Un letrado leyendo un libro de secretos naturales en que decia que el hombre que tiene la barba ancha era senal de muy necio, tomó una vela en la mano para mirarse á un espejo, porque era de noche, y quemóse por descuido la mitad dela barba, y escribió luego al margen, Probatum est.

IDIOMS.

1. Ladrar contra la luna.
2. Dorar la pildora.

3. Piedra que rueda no coje musgo.
4. Buscar cinco pies al gato.
5. Tener un pie en la sepultura.
6. Dar palo de ciego.
7. Al buen entendedor pocas palabras.
8. Despedirse á la francesa.
9. Nó hay que mentar la sogá en casa del ahorcado.
10. Por el dinero baila el perro.
11. En el pais de los ciegos el tuerto es el rey.
12. Hacer el caldo gordo.

PART II.

Candidates for the Second-class Certificate will have to translate six or seven of the above idioms, the following extract of Gil Blas, and the examples for the elucidation of grammatical questions:—

Blas de Santillana, mi padre, despues de haber servido muchos anos en los ejercitos de la monarquia Espanola, se retiró al lugar donde habia nacido. Casóse con una aldeana, y yo nací al mundo diez meses despues que se habian casado. Pasáronse á vivir á Oviedo, donde mi madre se acomodó por ama de gobierno, y mi padre por escudero. Como no tenian mas bienes que su salario, corria gran riesgo mi educacion de no haber sido la mejor, si Dios no me hubiere deparado un tio que era canonigo de aquella Iglesia. Llamabase Gil Perez, era hermano mayor de mi madre, y habia sido mi padrino. Figurete allá en tu imagination, lector mio, un hombre pequeno, de tres pies y medio de estatura, extraordinariamente gordo y con la cabeza zabullida entre los hombros, y hé aqui la vera efigie de mi tio. Por lo demas era un eclesiastico que solo pensaba en darse buena vida, quiero decir, en comer y tratarse bien para lo creal la suministraba suficientemente la renta de su prevenda.

1. Name the neuter article in Spanish. Example—Youth has not foresight of the future, experience of the past, nor moderation to conduct itself in the present.

2. What are the rules as to placing the adjectives before their nouns? Examples—The experienced pilot perceived (from afar) the towering summits of the mountains of Leucaba. The mild zephyrs, more powerful than the burning beams of the sun, preserved a grateful coolness.

3. When is the passive voice in English expressed in Spanish by prefixing the pronoun *se*? Examples—It has been said that the enemy will be surprised. The victory would have been gained by us, if our troops had not been twice repulsed.

PART III.

Candidates for the Third-class Certificate will have to translate half of the above extract from Gil Blas, to answer the grammatical questions, translating into Spanish their examples, and the following phrases:—

Let us have more indulgence. In order that I may have a benefice. The mother must have a mild temper. Are you right in telling such a history? I am wrong in speaking to you. Will your children be afraid at home? We are neither right nor wrong in hearing his reproaches. Let them all suffer the punishment, though only one may deserve it. Many shut their ears to the voice of conscience. They distribute their property among the poor. From that place they hear every thing easily. He died the following day. The groans attracted the attention of the hearers.

FREE-HAND DRAWING.

THREE HOURS ALLOWED.

Make a copy of the whole or part of one of the drawings which you have brought with you, so that the Examiner may judge whether the original work is your own doing. If you have not brought a drawing make a repetition from memory of any studies you have made during the last

twelve months; the original drawings should be sent in afterwards.

DIRECTIONS FOR THE LOCAL BOARDS.

Notice should be given to the candidates for examination in free-hand drawing, that they should bring any studies which they have finished during the last twelve months, as proofs of their abilities.

GEOMETRICAL DRAWING.

THREE HOURS ALLOWED.

The constructions must be accurate, and show clearly, by plain and dotted lines, with appropriate letters of reference, the principles on which they are based. They may be put in ink or left in pencil, at the discretion of the candidate, provided they are distinct.

No deviation from the conditions of the questions can be admitted; and since no candidate must answer more than one question from any one section, he is advised not to attempt more than the time will admit of his completing, since little or no credit will be given for incomplete or inaccurate answers.

I.

Divide a line 3.75 inches long—

1. Into two segments, so that the rectangle contained by them may be 2 inches in area.
2. Into two segments, such that the squares described on them may be as 3 : 2.
3. Into three segments, such that the rectangle contained by the whole line and the less segment may be equal to that contained by the other two.

II.

Construct a triangle from one of the following conditions—

1. Its sides as 3 : 3.5 : 4 and their sum 8 inches.
2. Its sides in that ratio, and its area 4 inches.
3. Its base 2.5 inches, its sides equal, and the angles at the base double that at the vertex.

III.

1. The sides of a rectangle are 2 and 3 inches; construct an equilateral triangle equal to it in area.
2. Construct a regular pentagon of 2 inches side, and a regular hexagon equal to it in area.
3. Inscribe a square in a hexagon of 2 inches side.

IV.

1. Two indefinite lines contain an angle of 50° , draw a circle of 1 inch radius to touch both.
2. A point is 1 inch from the circumference of a circle of 2 inches radius, draw a line from the point to cut the circle so that the intercepted chord be 2 inches long.
3. Draw a chord in a circle of 2 inches radius, so that the angle in the greater segment cut off by it may be 70° .

V.

1. Draw the plan of an equilateral triangle of 2.5 inches side when its corners are 1, 1.5, and 2.5 inches above the paper.
2. A square of 2.5 inches side lies in a plane inclined to the paper at an angle of 35° , and one side of the square is inclined to the paper at 20° , show it by a plan and elevation.
3. Draw the plan of the same square when two of its sides are inclined at 20° and 40° to the paper.

VI.

1. Draw a plan and elevation of a cube of 2.5 inches sides when three of its corners are 1, 2, 2.5 inches above the paper.
2. Draw the same cube when the planes of two of its faces are inclined at 35° and 70° to the paper.
3. A right prism, 3 inches long, with a pentagon of 1.25 inches side for its base, is to be represented in plan and elevation when the line joining one corner and the centre of the opposite end is vertical.

VII.

1. A sphere of 1.6 inch radius lies on the paper; represent an indefinite plane inclined at 50° touching the surface.
2. Draw the plan of the circle in which a plane having the same inclination of 50° cuts the sphere at 1 inch from its centre.
3. A right cone and a right cylinder have the same circle of 1.5 inches radius for their common base, and a height of 4 inches; determine the sections of both, made by a plane inclined at 70° to their common axis, and passing through its middle point, the true forms of the sections to be given.

VIII.

A rectangular block 4.5 inches long, 3 inches wide, and 2.25 inches high, has a prism of the same length and breadth, and 1.5 inches high, resting on its upper face; represent this solid, either—

- a. By a plan and elevation on a plane equally inclined to its two vertical faces.
- b. By an isometrical projection.
- c. By a perspective projection, the distance of the point of sight, &c., being at pleasure.

THEORY OF MUSIC.

THREE HOURS ALLOWED.

I. RUDIMENTS OF MUSICAL GRAMMAR.

(Nos. 1 to 6 must be answered on music paper, and in the order in which they are put.)

1. Put time signatures to

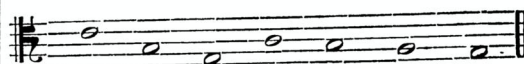


2. Write the signatures (essential sharps or flats) of *Fa* (F), *Sol* (G), *La* (A), and *Si b* (Bb) major; and of *Do* (C), *Re* (D), *Mi* (E), and *Fa* (F) minor.

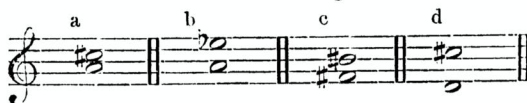
3. Transpose the following a third lower.



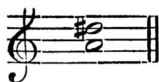
4. Write the scale of *Re* (D) minor, in every form with which you are acquainted.
5. Explain, by one or more examples of each, the following words:—Tetrachord, Syncopation, Augmented Second, Double Dot.
6. Write the following on the bass stave, at the same pitch.



7. What intervals do the following form?



8. In what scale are these two notes?



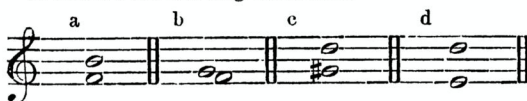
II. HARMONY, COUNTERPOINT, AND MUSICAL HISTORY.

(Nos. 1 to 6 to be answered on music paper.)

1. Place such a clef before the following as will make it $La(A)$.



2. Resolve the following dissonances.



3. Correct the following, without altering the first chord.



4. Add three parts to



5. Add a part in any kind of counterpoint above or below the following.



6. Harmonize the following.



7. State anything you know about English music and English musical composers in the seventeenth century.